Sky coverage optimisation and observational strategy

(written note available)

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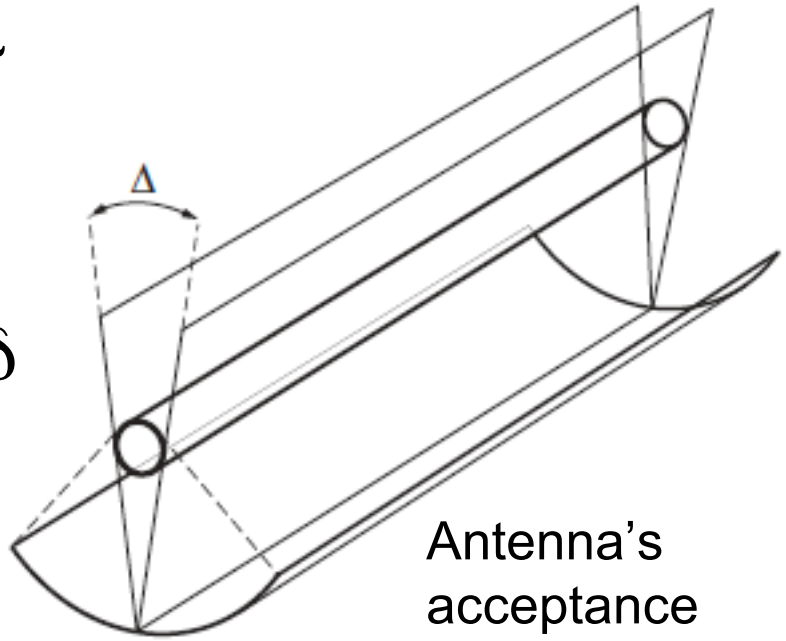
Ifrane, june 2009

Calculation of T_{exp}

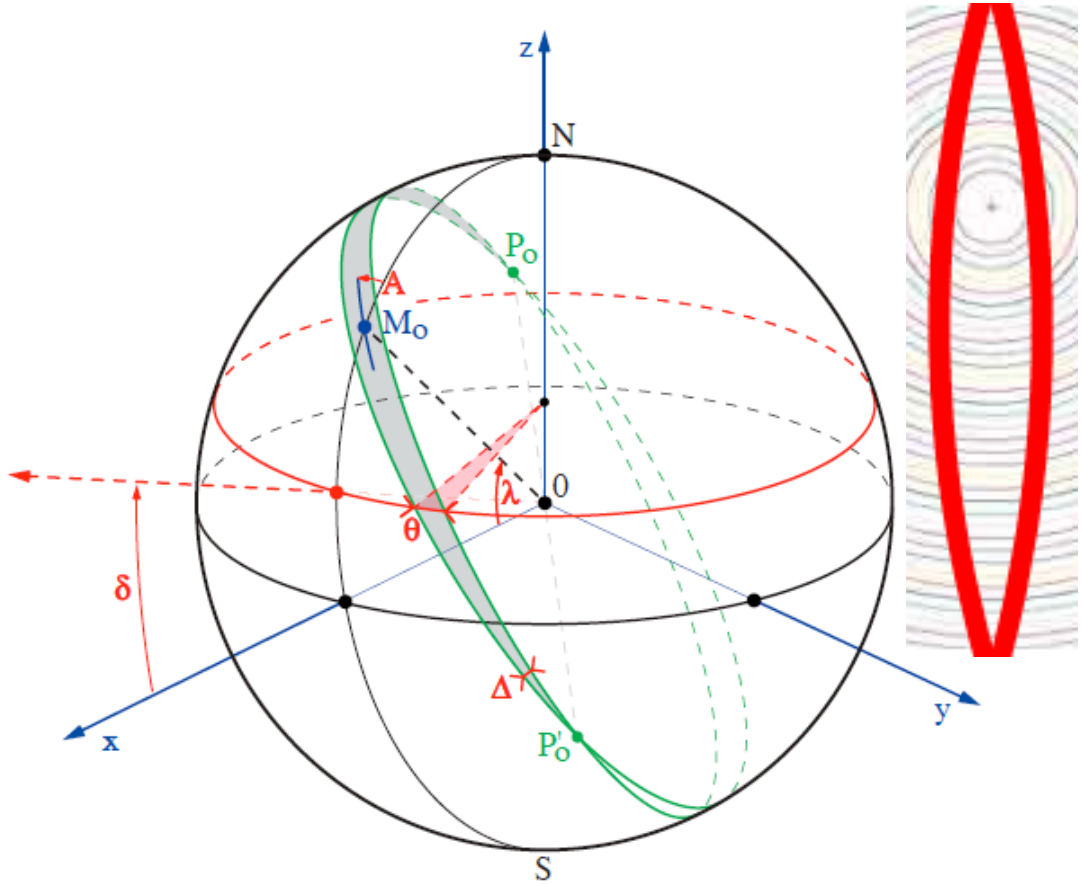
- Transit time in the lobe as a function of
  - Antenna's longitude λ
  - Azimuth A
  - Lobe size Δ
  - Declination of object δ



Combine with the detection lobe

- Sensitivity of dipoles depend on altitude if they are parallel to the cylinder
  - Compute an effective exposure time corrected by the lobe effect
- The other polarization (perpendicular to the cylinder) insensitive to the altitude

Geometry-notations



Daily exposure time at declination δ

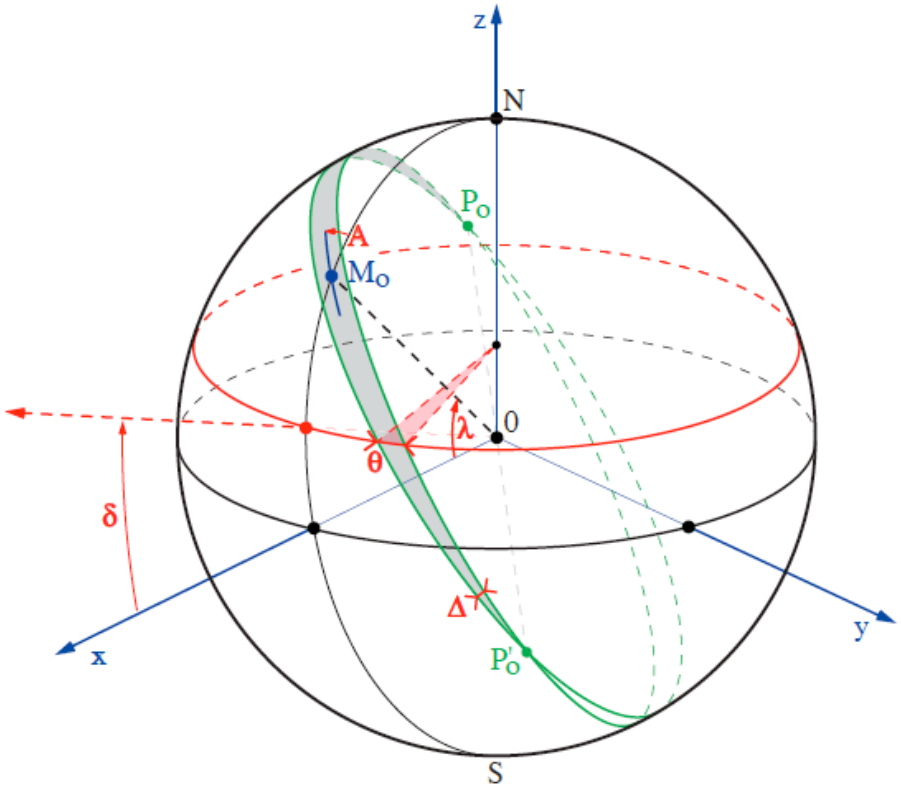
-> Fraction of the parallel within the lobe acceptance

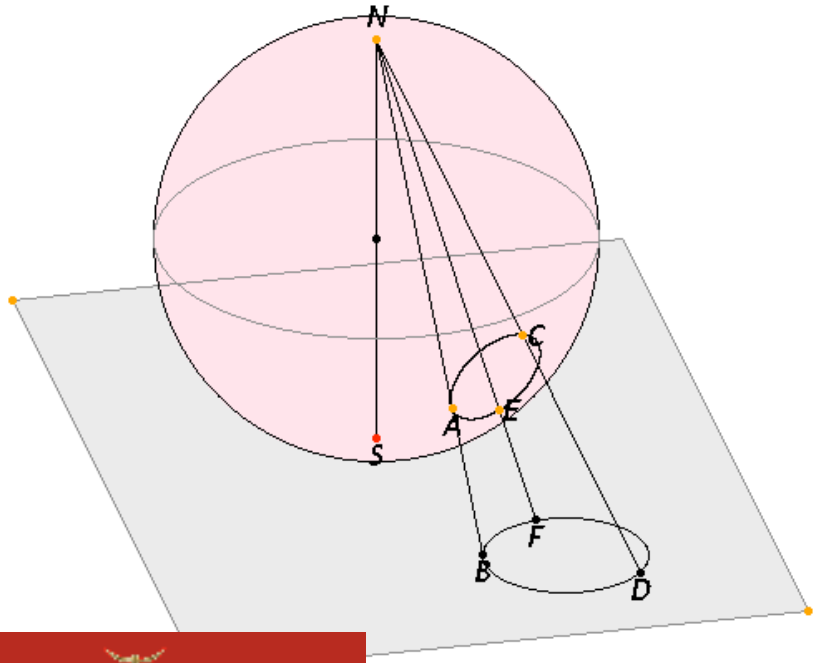
-> Depends on λ, A,Δ and δ.

Figure 2: *The celestial sphere with the projected position of the observer M_0 (latitude λ), the projected orientation of the reflector (A) and the projected portion of detectable sky (detection lobe), defined as the angular sector Δ of axis $P_0P'_0$ (in grey), where P_0 and P'_0 are the projections of the reflector's axis. $\theta/2\pi$ is the fraction of the day that an object of declination δ will spend within the detection lobe.*

The stereographic projection

- Preserves angles
- Circle -> circle or straight line





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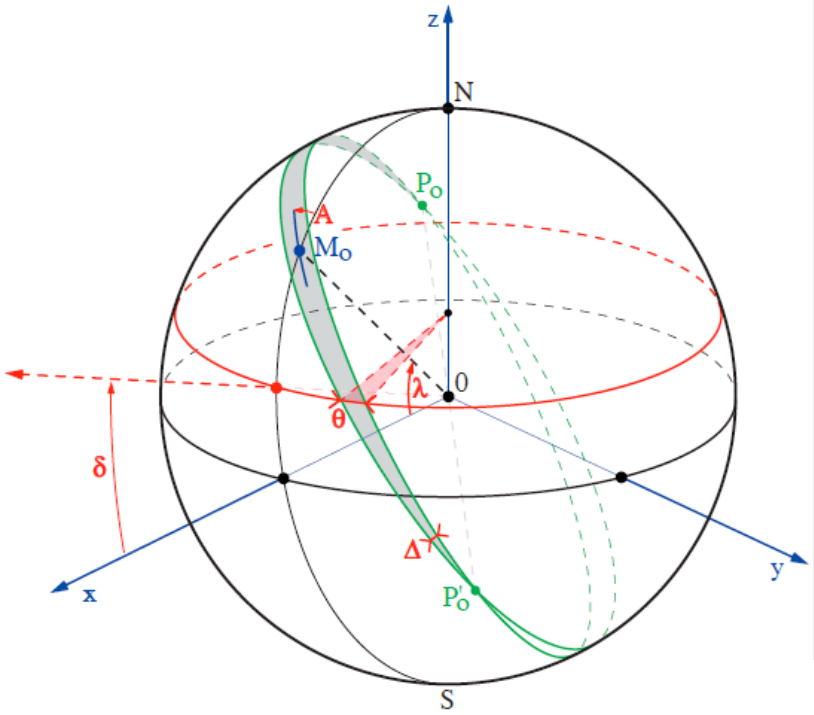
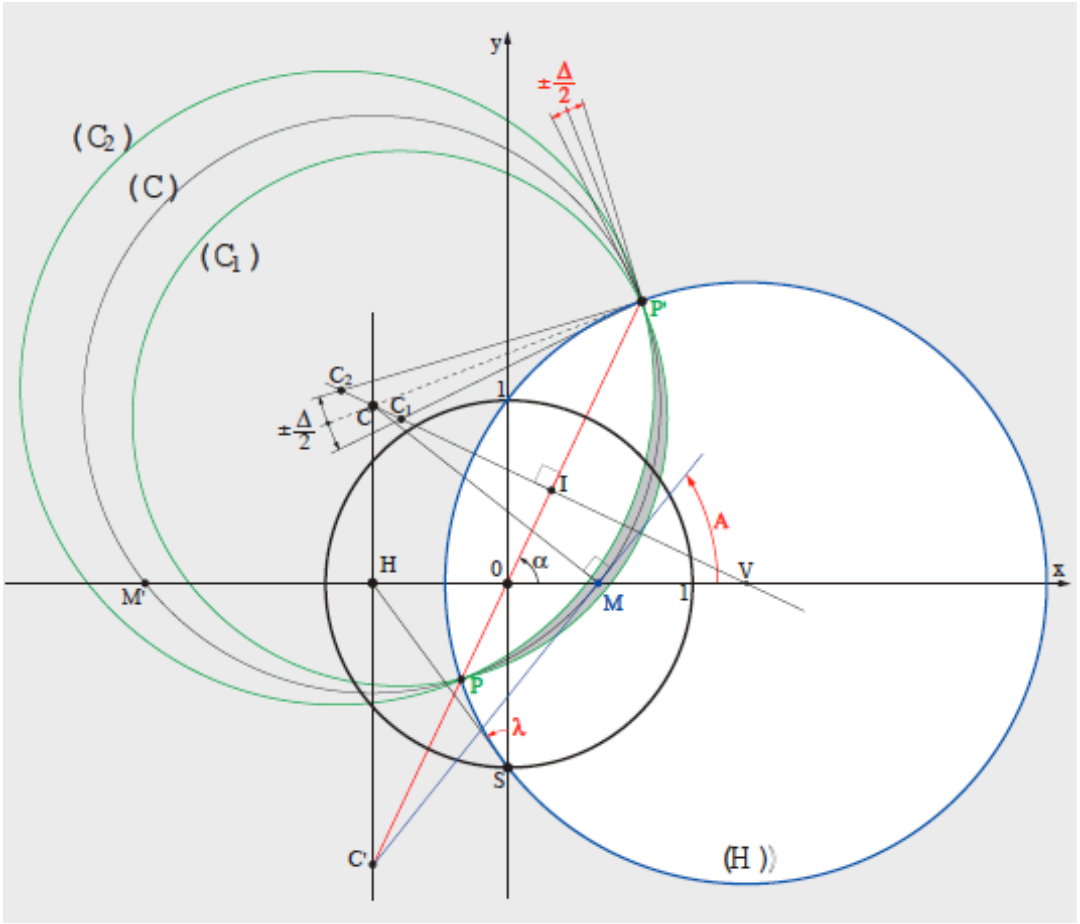


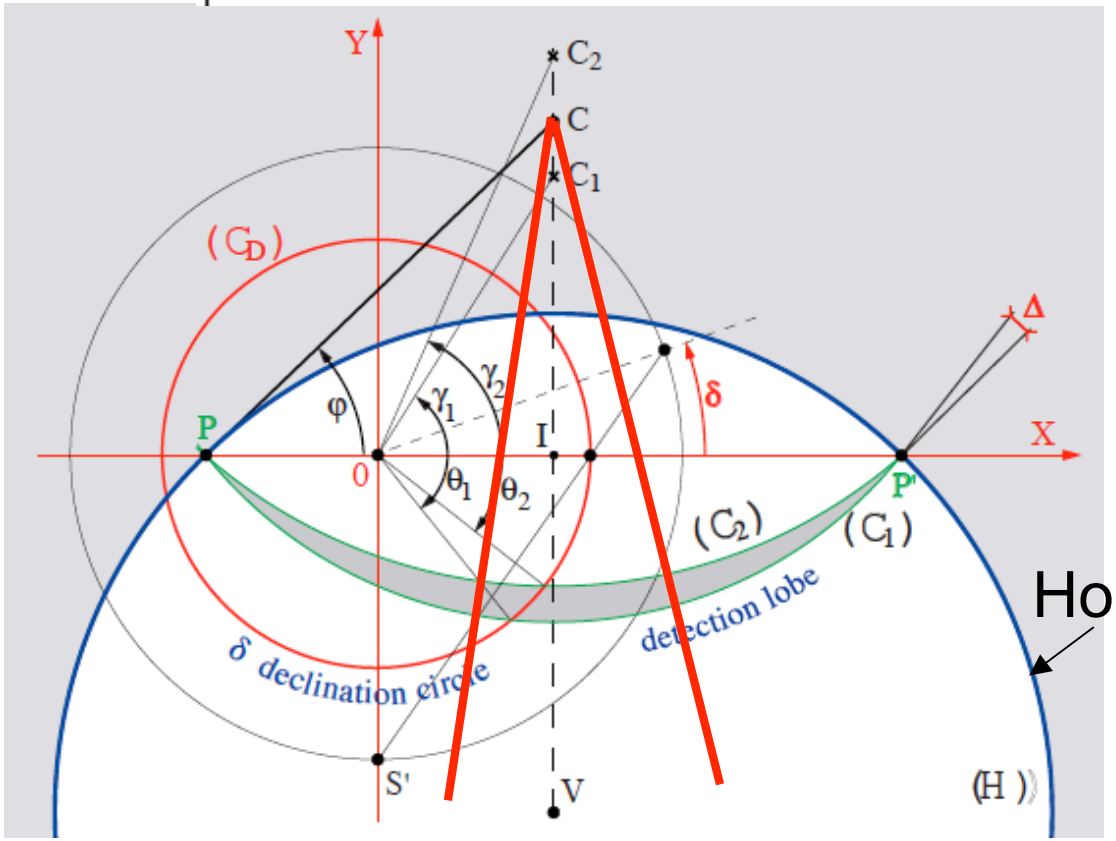


Exact formulae established

$$\theta_{-} = \arctan\left[\frac{\tan(\phi - \Delta/2)}{\cos\lambda\cos A}\right] \pm \arccos\left[-\tan\delta\sqrt{\frac{1-\cos^2\lambda\cos^2 A}{\cos^2\lambda\cos^2 A + \tan^2(\phi-\Delta/2)}}\right]$$

where

$$\tan\phi = \frac{\tan\lambda}{\sin A} \Rightarrow \tan(\phi-\Delta/2) = \frac{\tan\phi - \tan(\Delta/2)}{1+\tan\phi\tan(\Delta/2)} = \frac{\tan\lambda - \sin A\tan(\Delta/2)}{\sin A + \tan\lambda\tan(\Delta/2)}$$

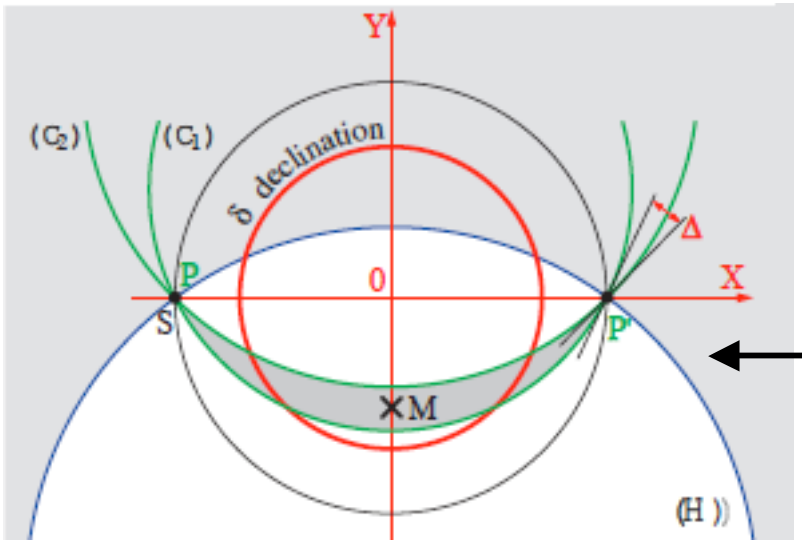


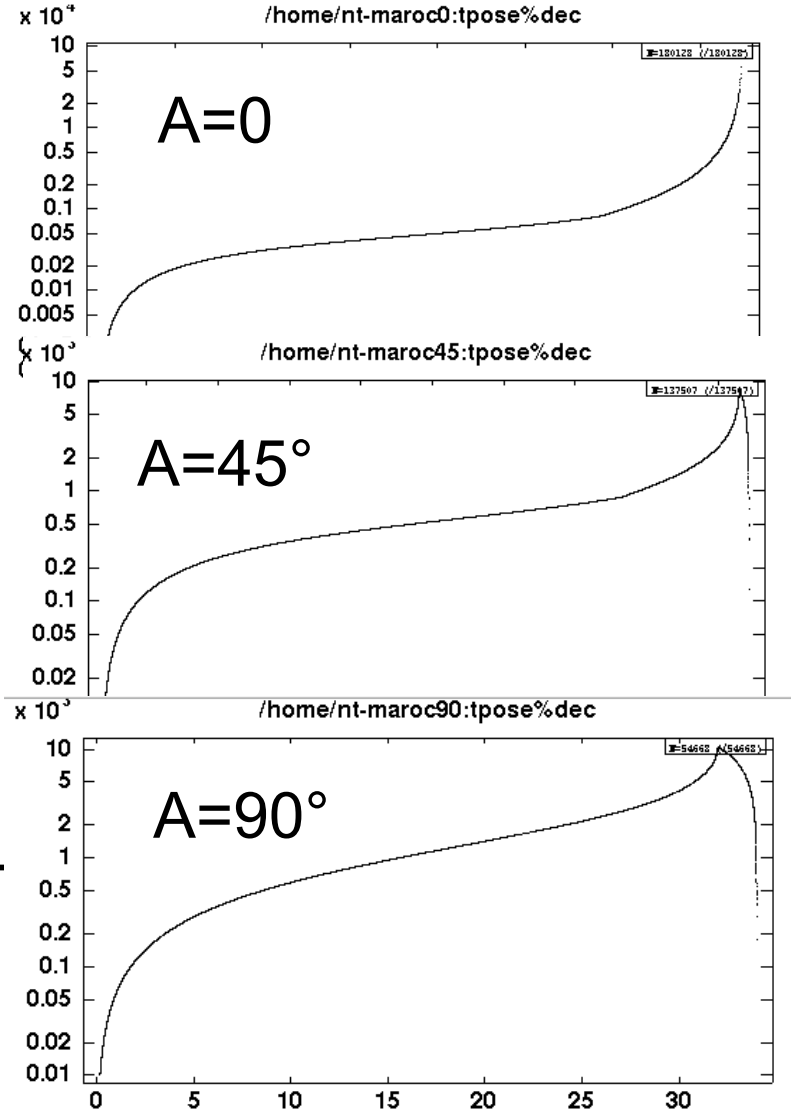
- Simple description in the projection plane
- « Easy » to feel the effect of a restricted sector in the lobe
- Effect of the antenna's sensitivity: function of the position along the lobe

Horizon

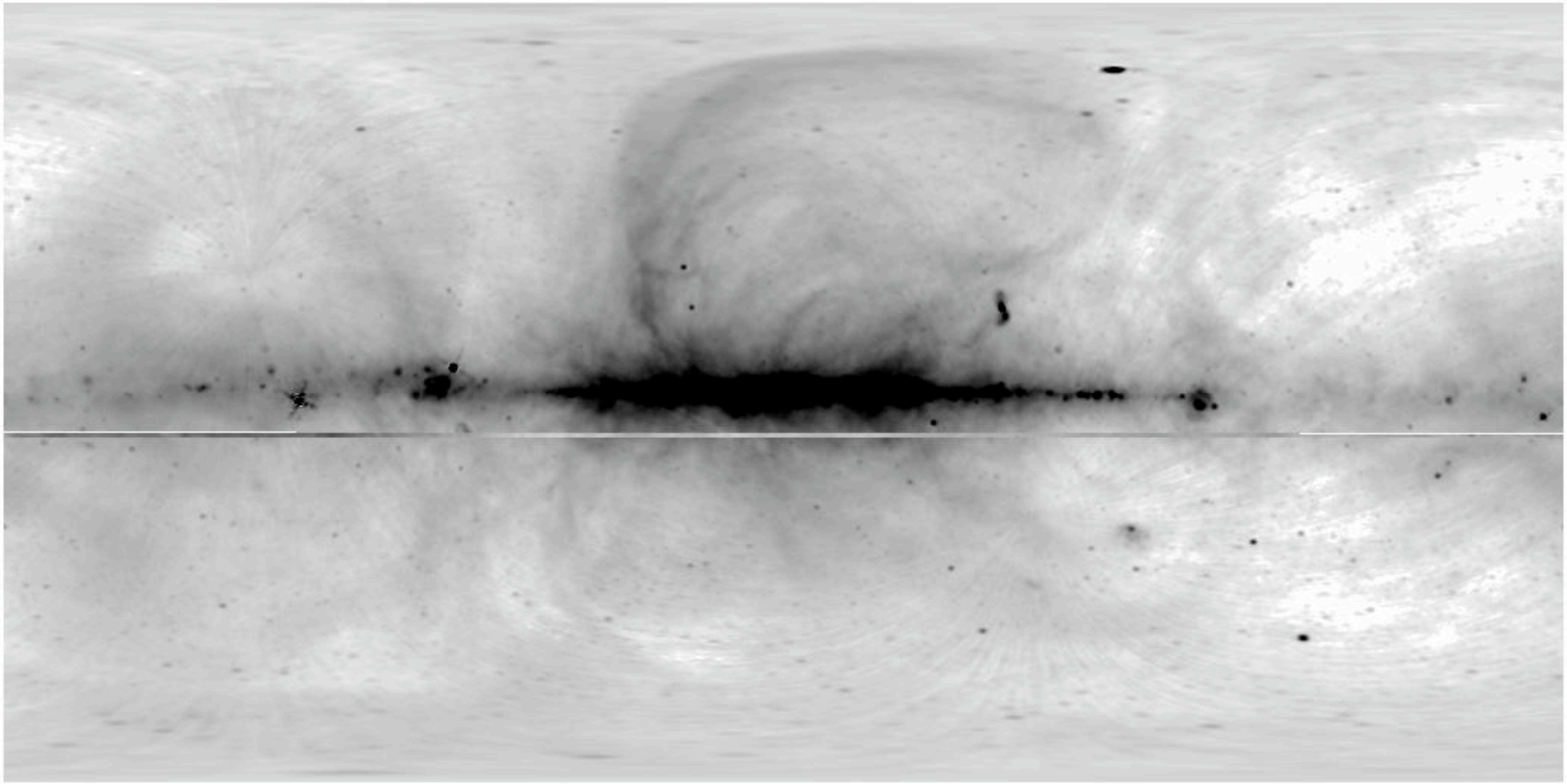
Morroco
(latitude 33°)

Assume Δ=2°

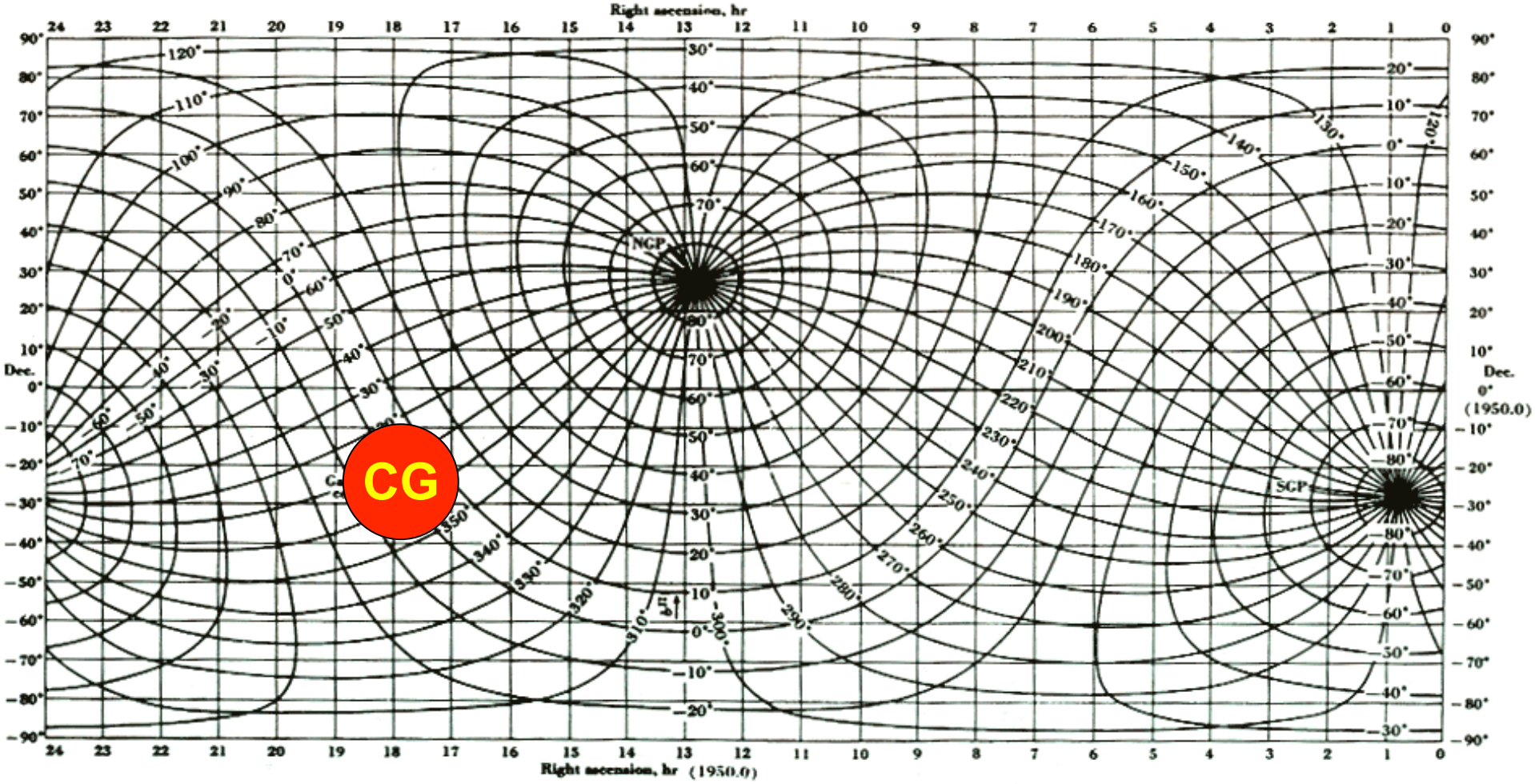




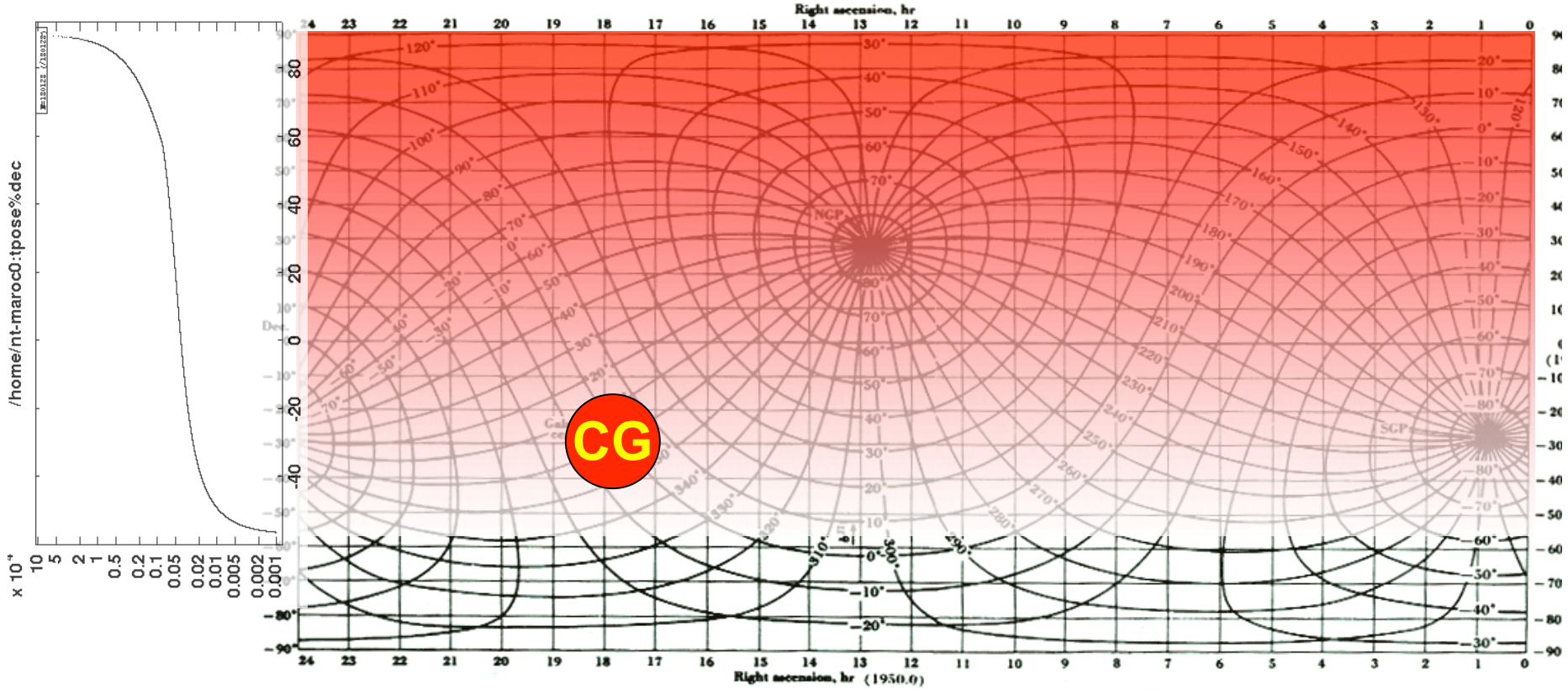
Synchrotron galactic emission



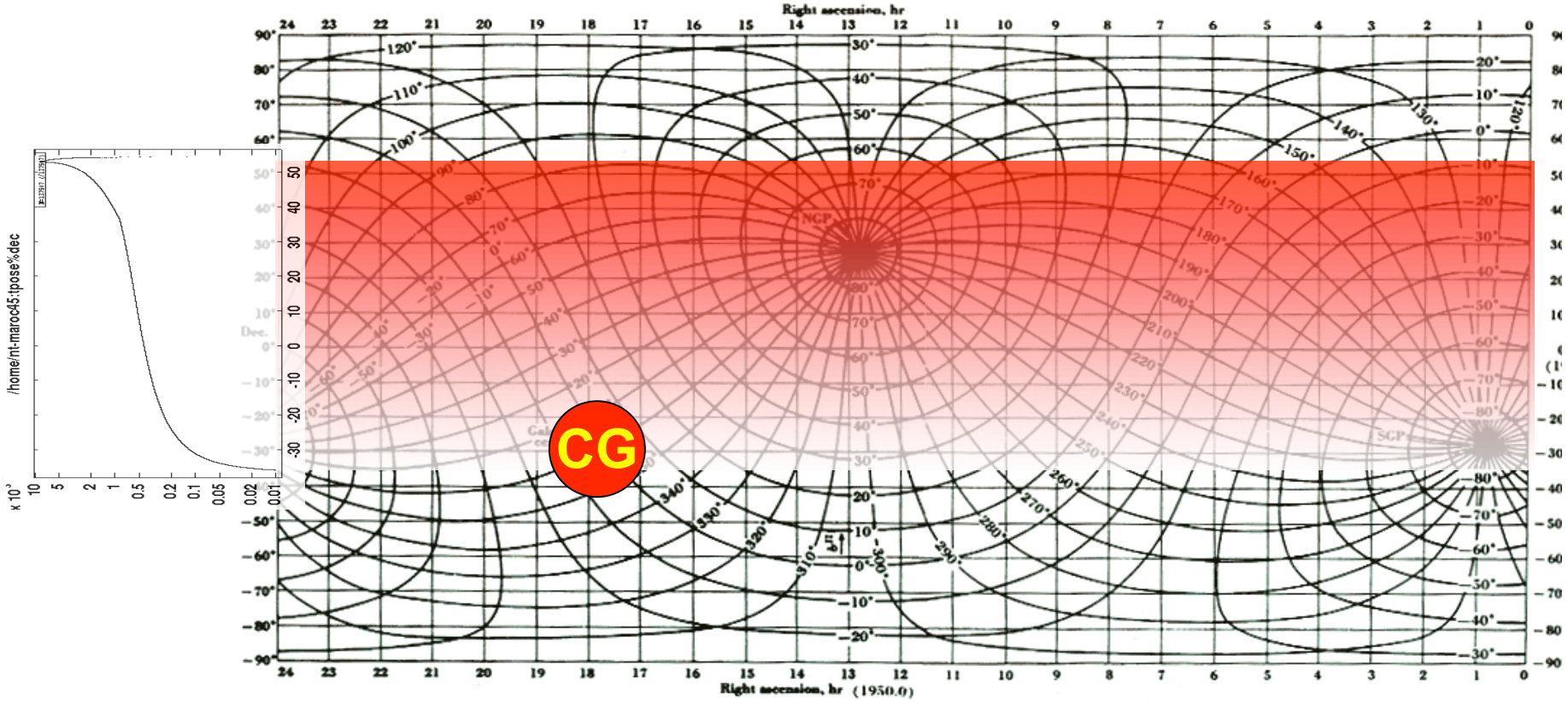
Avoid galactic plane



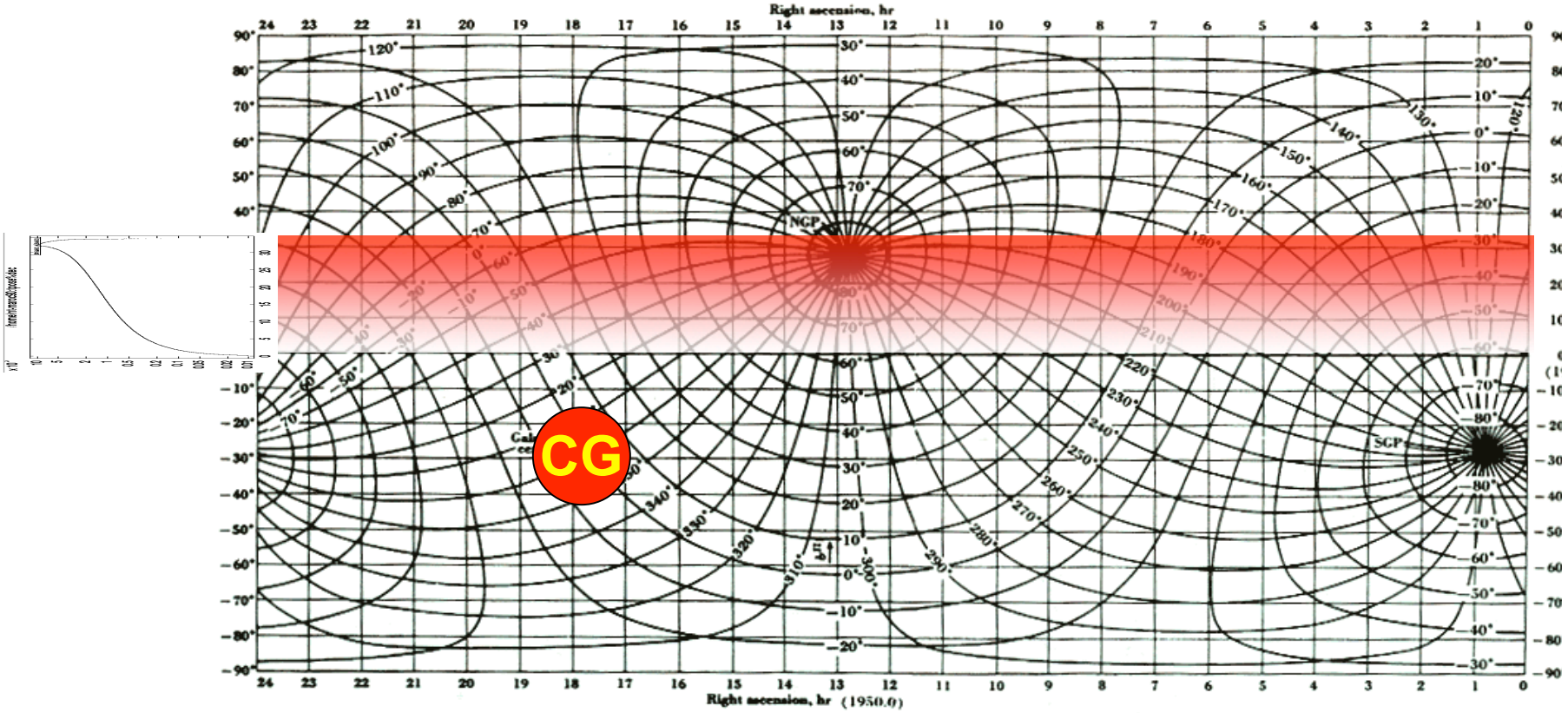
Morroco A=0


/home/nt-maroc0:tpose%dec
x 10⁺⁴
Right ascension, hr
Right ascension, hr (1950.0)
NGP
SGP
CG

Morroco A=45°


/home/nt-maroc45:tpose%dec
CG
Right ascension, hr
Right ascension, hr (1950.0)
NGP
SGP

Morroco A=90°



Synchrotron emission

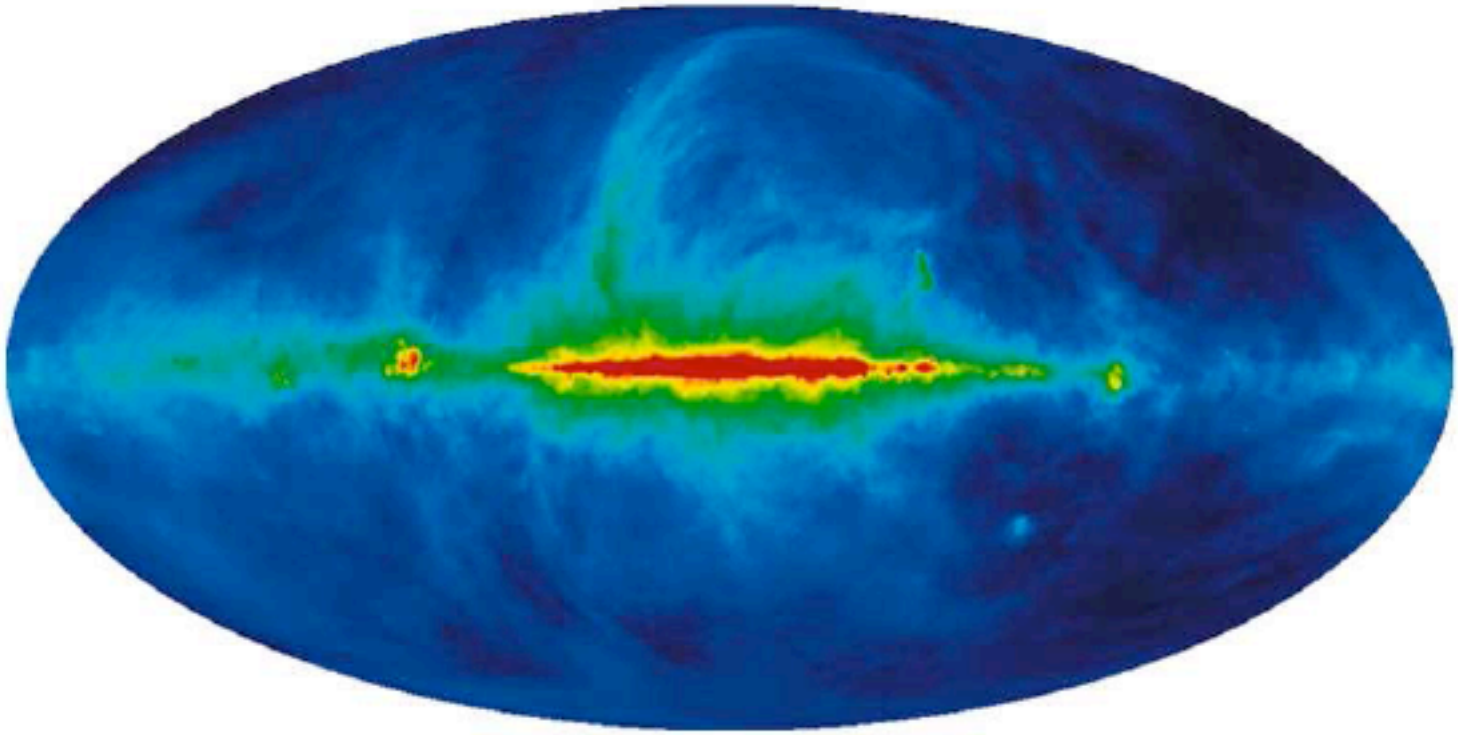


Figure 9: *The Haslam map of the synchrotron galactic emission at 408 MHz (galactic coordinates).*

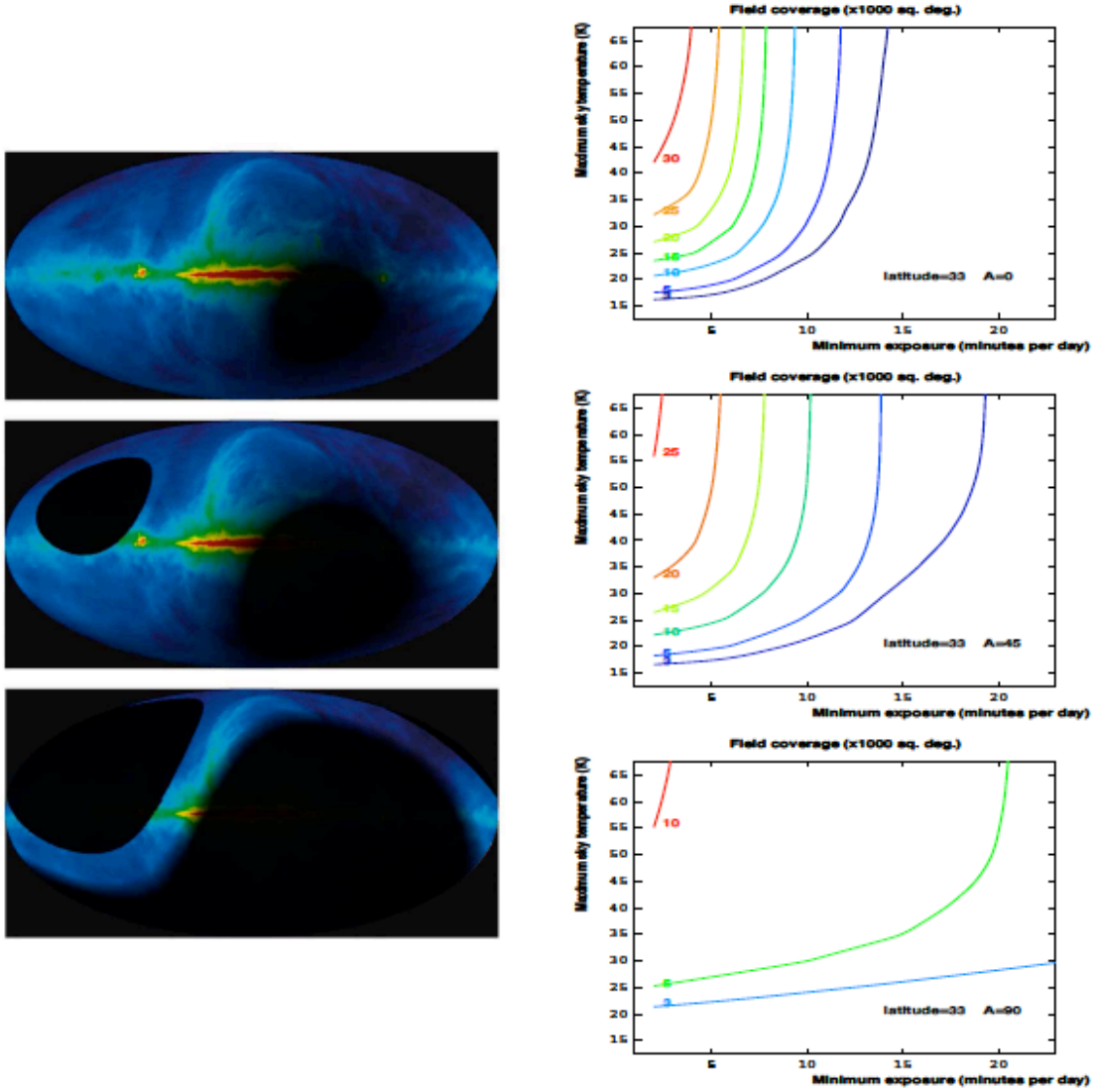


Figure 11:

Antenna located in central Marocco latitude.
LEFT: Sky visibility (proportional to the Exposure time) as a function of galactic coordinates.
From top to bottom: antenna azimuth $A = 0°$ (North-South), $A = 45°$ and $A = 90°$ (East-West).
RIGHT: field covered by the antenna as a function of the minimum daily exposure and the maximum synchrotron sky temperature.

Morroco site

- For $A = 0°$, 28200 square degree (68%) of the sky are covered with a daily exposure larger than 300s, and 1150 square degree (3%) are covered with an exposure larger than 1500s.
- For $45°$, 22200 square degree (54%) of the sky are covered with a daily exposure larger than 300s, and 2100 square degree (5%) are covered with an exposure larger than 1500s.
- For $90°$, 9600 square degree (23%) of the sky are covered with a daily exposure larger than 300s, and 4200 square degree (10%) are covered with an exposure larger than 1500s.

Conclusions. To be done

- Effective exposure = transit time x antenna lobe
- Flexibility
  - Choice of orientation A
  - choice of the sector (if not 180°).
- Optimize strategy by combining large field/short exp. (measure small k) and small field/large exposure (large k, not limited by cosmic variance)
- Some margin to favour specific bands in latitude (with low synchrotron)
- Factor of merit: integral(T_{exp}/Synchrotron)